

**EFFECTIVENESS OF FOOT PRONATION CORRECTION
EXERCISES IN CLASSICAL BALLET DANCERS WITH
POSTERIOR ANKLE IMPINGEMENT SYNDROME**

DISSERTATION

Submitted for the partial fulfillment of the requirement for the degree of

MASTER OF PHYSIOTHERAPY (MPT)

(Elective MPT –ORTHO)

MAY-2019

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ACKNOWLEDGEMENT

I would like to express gratitude to my **LORD ALMIGHTY** for his abundant blessings and mercy be showered upon me always.

Then I would like to thank my beloved parents, for encouraging me a lot in finishing the project.

I express my sincere thanks to our principal **PROF.VIJAIKRISHNA, MPT(CARDIO)MIAP** for his valuable suggestions and inspiration during this study.

I could not have accomplished this task without the guidance and co ordination received from my guide **PROF. MRS. S. MERCY CLARA, MPT (ORTHO)MIAP**. I would like to convey my heartfelt thanks for her restless guidance and patient advice in each step of the course of this study.

I also wish to thank my dear friends and colleagues for their support in completing this study.

A Special word of appreciation for the kind co operation to my patients who believed in me and co operated to their extent .I owe my gratitude to all ,who were very helpful in completing this project.

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1.INTRODUCTION

The art of performing Ballet is very stressful and demanding on the body.¹ Dancers must be able to execute complicated dance portions and still maintain grace and flow as they move from one position to the next. Dancing on the balls of the feet or tip of toes is extremely demanding causing considerable biomechanical load on the skeletal elements of the lower leg and the foot².

Due to repetitive nature of ball training, young ballet dancers often incur into overuse injuries most often along with technique dysfunction.

Ballet dancers spend numerous hours performing the same or similar movements patterns every day or frequently for years together.

According to the study, the foot and ankle are the most vulnerable anatomic segments in the ballet dancers are prone to the ankle injury³.

Consistency of the repetitive use of forced plantar flexion at extreme ranges of motion of the ankle and foot, en pointe and demi pointe positions.

The injury results from dysfunctional alignment, proprioceptive imbalance, involvement of kinetic chain in a joint, the ankle kinetic chain is considered while treating a foot or an ankle Injury⁴.

Pain in the posterior ankle of female ballet dancers can result from many causes and may represent a diagnostic challenge PAIS. Posterior ankle impingement syndrome is by decreasing the space between the tibia and the calcaneus compressing the soft tissues or bony structures sometimes found in the posterior ankle anatomy.

PAIS is one of the most misdiagnosed ankle injuries among ballet dancers which may lead to serious repetitions in technical progression or even to career end.

PAIS is the condition characterized by soft tissue damage at the back of the ankle joint, due to compression of these tissues, during maximal ankle plantar flexion⁵.

When the foot and ankle are pointed maximally away from the body (Plantar flexion) the ankle is compressed at the back of the joint. This may result in tissue damage and pain if the compression forces are too repetitive or forceful particularly swelling in the ankle or bony prominence such as a additional bone known as os Trigonum. This is otherwise called as the “PAIS”⁶

Most pain is felt at night or early times of morning. It is commonly found in gymnasts, ballet dancers and footballers all of whom maximally plantar flex their ankles during their activities ,it is also commonly seen in the front loading leg of fast bowlers in cricket.

Symptoms of PAIS typically presenting pain with sharp pain, aches at rest, activities in tippy toes, pointe work (dancing), Jumping, landing, Based on history and physical assessment findings. In some cases, your physiotherapist may recommend that you obtain some imaging based upon the presentation, the diagnostics is diagnosed⁷

Problems can arise with too little pronation because there isn't enough shock absorption through the foot. Too much pronation can lead to its own set of problems also. Shock is not getting absorbed properly either the problem with shock absorption is that it can lead to issue like shin splints, Dancers heel ,Hammer toe, Plantar fascitis ,Achilles Tendinopathy⁸.

Acute stage :-

PRICE – pain relief – minimize the swelling and injury protection are done in initial stages. Rest (Active) one first aim is to provide rest relief of pain in movements and posture, Activities should be stopped that provokes recurrence in ankle movements. Ice – is the simple effective modality to reduce the pain and swelling. Has to apply for 20 – 30 min's each 2 to 4 hrs during initial phase – compression a crep bandage, tube grip compression stocking or kinesiology supportive taping will help and support the injured tissues. Elevation – may assist to gravity reduce excessive swelling around the ankle. Bracing and deloading techniques are done to aggravating activities and alternative exercise sessions are held.

These managements are done to restore the full range of motion and aiming at regaining full active Range of motion of the ankle⁹.

Sub Acute Injury Treatment :-

Local modalities are used to assist pain reduction and natural response via an increase in energy modalities have short term benefits that can assist with the earlier introduction of other longer lasting Techniques such as exercise prescription.

Example of Local modalities includes :-

Ice, Ultrasound ,Tens .

Soft tissue massage – massages like Trigger point Therapy etc can be given¹⁰.

Protective strapping / Support / Brace :-

Limiting or supporting the injury in the sub – acute phase is often recommended to ensure the tissue repair is optimized.

Exercise prescriptions

Exercise prescription has been shown by researchers to be the most effective method to hasten recovery, reducing pain and improve your post injury function

Strengthening Exercises, Balance Exercises, Range of motion Exercises, OKCE,CKCE along with foot posture correction Exercises.¹¹

1.2 AIM OF THE STUDY :-

The main goal of this research is to understand Posterior Ankle Impingement Syndrome clinical and functional features within the dance practice, especially considering classic ballet. The aim is to modify the essentials for designing targeted strategies in prevention of Recurrent treatment. To provide stability increase ROM, and to maintain correct posture by recruiting some of the correction exercises.

1.3 NEED OF THE STUDY :-

None of the studies have focused on foot posture correction in managing posterior ankle Impingement syndrome. So my study aims at finding the effectiveness of foot posture correction along with conventional exercise in treating Posterior Ankle Impingement Syndrome.

1.4 HYPOTHESIS

There is significant improvement in pain and functional ability in with “ POSTERIOR ANKLE IMPINGEMENT SYNDROME ” by including foot posture corrections exercises along with conventional therapy

1.5 OPERATIONAL DEFINITIONS

PAIS – Posterior Ankle Impingement syndrome is a condition characterized by tissue damage at the back of the ankle joint due to compression of the tissues during maximum ankle plantar flexion.

ROM – Range of motion – to improve movements.

OKCE – Open kinematic chain exercises does not remains constant with a surface done on non-weight bearing.

CKCE – Close kinematic chain exercises remains constant with a surface done on weight bearing.

NRPS – Numerical pain rating scale is a reliable pain scale for using to measure the pain rate.

FAAM – Foot ankle ability measure is a reliable tool for measuring the ability of the measure.

2. REVIEW OF LITERATURE

Dimmick S, Linklater J, Kevin J (2016) – This Ankle impingement study is common with certain population of athletes who repeatedly dorsiflex or plantar flex and or have history of inversion ankle sprains and other micro trauma. Current literature favours surgical intervention as treatment. There is a limited amount of high quality evidence for correlative management. Physical therapy including manual therapy, exercise that aim to increase mobility of the ankle joint and decrease pain with ambulation¹².

Robinson p, White . LM (2007) - this study suggested that initial treatment of PAIS should focus on decreasing inflammation, non- steroidal anti inflammatory drugs and activity restriction (avoidance of hyper plantar flexion) further physical therapy that included soft tissue therapy stretching and adjustments of restricted joints of the lower kinetic chain should be done in conjunction with Progressive strengthening. This review should that athletes and dancers with a history of ankle sprain have 70% fewer ankle sprains when taped or braced in comparison with those who did not wear prophylactic support¹³.

Isabelle Senecal , (2011) This study suggested that conservative management may be recommended as a first line treatment for PAIS, however the literature is lacking to support specific conservative management strategies Rehabilitation program applied vigorously play an important role in the therapeutic management of PAIS ; it is an effective way to avoid surgery in many cases – A personalized strengthening program in conjunction with proprioception and balance exercises that progressively increase in intensity help improve static and dynamic stabilization of the ankle and prevent recurrence of injury. In case of failure to conservative care, surgery can be option to consider.¹⁴

Hobdin R , Aubin B (2000) - This study suggests that the treatment for PAIS varies depending of the case of the impingement. Currently the literature is lacking good quality outcome studies investigating the optimal treatment of ankle impingement¹⁵.

Geppert MJ (1996) – Stated in this study that the non – operative or conservative treatment, consists initially of limitations of painful activities including pointe work, and physical therapy to work on mobilization of the ankle joint. Having the dancers sleep with a night splint may help reduce stiffness and synovitis and some dancers benefit from changing their Pointe shoe style and fit to a shoe, such as a half or three quarter shank that allows the dancers to achieve full pointe position with less compression in the posterior structures¹⁶.

Kalina R, Neoral (2011) - The study stated that when the source of impingement is os trigonum and must be removed, the advised approach should be on the ankle posterior lateral aspect. When the source of impingement or disability is FHL tendon sheath that sometimes may co – exist with OS trigonum. The surgical approach should be posterior medial after surgery physiotherapy and technical errors corrections are recommended¹⁷.

Wredmark T, Bauer (1991) – The study stated that the use of non – steroidal anti – inflammatory drugs can help but they should be used only as a pain of an overall treatment program and not as, simply to cure the pain so that the dancer can continue dancing and ignore symptoms¹⁸.

Deepak P. Patikar (1998) – This review stated that the ballet injury pertains to the physical therapist. The articles have reviewed ballet injury prevalence and mechanisms of injury. It was revealed that inappropriately fitting footwear lead to various foot conditions and abnormal lower kinetic chain biomechanics. In addition, some clinical recommendations have been made regarding the physical therapy management of ballet injuries¹⁹.

D. Caine (2016) - This review focuses on many of the foot and ankle injuries commonly seen among dancers. These unique athletes place extreme demands on their musculo skeletal system and thereby faces a variety of acute and overuse injuries²⁰.

Joel Schwarz (2000) - This study stated that the extreme positions created when dancing on pointe, or on the tip of the toes, or in the demi pointe positions, on the balls of the feet with the ankle plantar flexed, can lead to both acute and overuse injuries of the foot and ankle are although dancers develop overuse injuries. Common in other athletes, they are also susceptible to unique injuries this article reviews common foot and ankle problems seen in dancers and provides some basic diagnosis and conservative treatment strategies²¹.

Andrea Fergus, Joyce Maring (1994) - reported that a generalized exercise program with foot gymnastics has improved foot and ankle function. The participants in the program showed improvements in muscle strength and gait speed who had generalized exercise session²².

Benedetti (2004) -. Stated that an exercise program targeting flexibility and strength gain regulated in participants improved strength, ROM and posture correction, in foot and ankle²³.

Fransico Jose Sobrino (2015) – The consistent article states that the female ballet dancers all particularly more prone to this injury because of their extreme ROM of ankle and foot joints. The forceful plantar flexion that occurs during the en pointe and full demipointe positions produces compression at the posterior an anatomic structures normally present between the posterior part of tibia through Corrective Exercise gradually increases, progressively reducing the distance between the calcaneus and the posterior part of distal tibia²⁴.

Jefferey A Russell (2013) – The consistent article is proposed to be associated with foot / ankle pain and poor function those affected may experience pain sometime functional impairment. Less severe cases are eligible for non – surgical treatment and foot orthoses are considered to be the first approach. Furthermore strengthening and ankle stabilizing muscles are thought to contribute to activate the stress relief or soft tissue structures. Combined Eccentric, strengthening ankle stabilization Ex's are encouraged kinematic data Analysis exercises are done for the management strategies²⁵.

Aena Aalten (2014) – documented ankle motion in dancers or other activities, depending on how forces are applied to the levers of the skeleton. The type of injury is seen in ankle joint depending on the motion being performed and the kinetic chain involved, open or closed if the lower extremity is whether or not weight bearing regarding the injury mechanism some of the Kinetic chain exercises are involved to activate the mechanisms. And conservative managements are given, in failures of conservative management surgery is approached²⁶.

3. DESIGN AND METHODOLOGY

3.1 Study Design

Experimental study design.

3.2 Study setting

The study was conducted in Jelly fish dance company,

Smasher sport academy, 372, 5th link Road Nehru nagar, Alwarpet.

3.3 Study duration

14 Weeks

3.4 Sample Size

Thirty subjects from the population where selected by two different groups of methods. (15 each)

3.5: Sampling Technique

Convenient sampling technique

30 patients diagnosed with PAIS through hyper plantar flexion test-into two groups, Group A and Group B.

Group A-OKCE,CKCE along with strengthening exercise , Balance exercise, Stretching exercises done for 15subjects.

Group B-OKCE,CKCE along with correction exercises for 15 subjects as a conservative management.

3.6 : Sampling criteria

Inclusion Criteria

Age 18-25 yrs.

Commonly affects females than males.

Current symptoms pain and stiffness (6 months) during weight Bearing activities.

Early morning stiffness subsiding within 30 minutes on activity

Exclusion Criteria

Radiating pain to the upper limb

Malignancy

Infection

Osteoporosis

Recent surgeries of lower limb

Extremity mainly foot and ankle joint.

3.7 Variables

Dependent variables

1. Pain
2. Functional ability

Independent variables

1. Strengthening, stretching, balance, OKCE and CKCE
2. Foot posture correction exercises.

3.8 Tools And Material Used :-

Pen, Scale, Towel, Foot Stool, Assessment chart, Consent Form.

3.9 Procedure

The subject selection was based on the following inclusive and exclusive criteria the study was explained to the patients and an oral consent to participate in the study was obtained.

30 patients were selected and assigned randomly into two groups 15 subjects were in each group using (NRPS) Numerical Rating Pain Scale and (FAAM) Foot & Ankle Ability measure.

GROUP A (CONTROL):

15 Subjects underwent an following exercise protocol like strengthening Exercises,

Balance Exercise, Open kinematic chain Exercises and Close kinematics chain exercise are given.

Timeline	Goal	Exercise Description
Weeks 1 -2	<ul style="list-style-type: none">• Oedema control• Pain free ROM avoidance of planter flexion : neutral ankle position• Return to activities of daily living	<ul style="list-style-type: none">• Open Kinetic chain (OKC).• 15 subjects in acute with injured ankle 15 subjects in sub acute with thera band in direction – inversion eversion, flexion, extension.• Close kinetic chain (CKC)• Bipedal strengthening holds forefoot on step (50 sec to 100 secs 30 sec to 3 mins)
Week 3-4	<ul style="list-style-type: none">• Improvement of static ankle stability• improvement of dynamic ankle stability• Partial ankle dorsiflexion was begun (5 degree)	<ul style="list-style-type: none">• Unipedal isometric holds (5x10 sec, 10x10 secs)• Alternate bipedal and unipedal squat 4x 5 sec 4 x 15 sec• Balance on a dyna disc (Injured ankle) Alternate eyes open eyes closed eyes 3 x 1 mins

Week 7 – 10	<ul style="list-style-type: none"> Increasing ankle load Tolerance Introduction to plyometrics 	<ul style="list-style-type: none"> Exercise prescription CKCE with dynamic stabilization 2 legged foot jump – landing on one leg (2 min's) 2 Ledgged jump 90⁰ turn in air landing on leg (both 2 x 1 min's) Front jump 1 leg (2 x 1) repetition side jump leg (2 x 1 on kg) Rope jump (5 x 1 min) walk, run intervals of treadmill alternate one day; rope
Weeks 11-14	Return to function	<ul style="list-style-type: none"> Running pattern acceleration / deceleration (minimum 2 x 1) Cut and turns 2 x 5 each direction Forward and backward repetition (each direction) Exercises above week (20 mins direction) Rope jumping continued between running ex's other day (20 mins duration)

UNIPEDAL ISOMETRIC HOLD EXERCISE



TWO LEGED FOOT JUMP EXERCISE



GROUP B (EXPERIMENTAL) :

15 subjects underwent an following exercise protocol like strengthening Exercises, Balance Ex's, OKCE and CKC Exercises and along with that foot corrective exercises are given as a conservative strategy to improve ROM and foot posture in the ankle

In order to improve ROM conventional exercises like stretching. Strengthening.

Balance OKCE and CKCE are given

As mentioned above. In group B along with then conventional therapy posture correction Exercises protocol are sessioned as a conservative management of PAIS 62.7% in group B got well improved after foot posture correction exercise than the group A subject.

The best way to determine overpronation and way of correcting the overpronation To evaluate whether the foot is overpronated,look to see if the arch is dropped or absent and /or if the soft tissue of the fallen arch bulges out on the inside of the foot.

Bare foot Running :

Running Bare foot can decrease pronation because running shoes have extra weight for cushioning at the heel of the shoes, causing the dancer to heel strike more, leads to correct over pronation

Teaching neutral foot and Ankle Position :

To teach the neutral foot position for the foot and ankle. These are two small indentations at the base of place your thumb on the dimple inside of the ankle and your forefinger on the dimple one on the outside .The patient is asked o roll the foot and ankle inward [overpronation] . The therapist feels the pressure in the thumb , and ask the patient to roll outward [oversupinates] the pressure is felt by the therapist coach the patient until a pressure in talus bone is observed in both thumb and fore fingers this is the anatomical neutral position of foot and ankle . Most people will have to supinate to get neutral from their dysfunction over pronation position of foot.

Exercise recommendations for foot correction are:

1. TOE SPLAY
2. TOWEL GRAB
3. DUCK STAND
4. GOLF BALL ROLL
5. BIG TOE PUSH DOWNS
6. SQUATS
7. SINGLE LEG SQUATS
8. LUNGES

TOE SPLAY:-

A overpronation foot has very less space in the toes leads to mal alignment, so more concentration on correction is done in space of toes .This allows the toes to stabilize the foot and ankle in neutral position .

TOWEL GRAB:-

To perform this exercise ,sit on a chair or bench , spread a towel out on the floor in front of the therapist and place one foot on it. Grab the towel with your toes to pull it in under the foot .keep going until the patient reeled the towel all the way in , then straighten out the towel and go again but just grabing the towel strengthen the muscles and neutralize the foot and realigns the ankle . Perform twice on each foot, alternating feet

TOWEL GRAB EXERCISE



DUCK STAND:-

This exercise retrains the foot and the ankle complex to correct the overpronation. Exercise is performed wearing shoes, or for greater challenges in bare foot .This exercise is designed to prepare for the more dynamics by the gluteus muscles to control the degree of foot pronation .when the gluteus contracts concentrically they rotate the leg outward as the leg rotate outwards ,the arch of foot raises(i.e) supinates. Duck stand is done and positioned for 30 seconds.

DUCK STAND EXERCISE



BIG TOE PUSH DOWN:-

This exercise is designed to strengthen the muscles of big toe that holds up the arch of foot (i.e) flexor hallucis longus muscle. This stops the foot from overpronating. Stand on the top of the foot facing forward .use gluteal muscles to raise the arches of foot keep arches raised while pushing down big toe, tension build in the arch on the underside of the foot is felt. Realignment is developed slowly, by holding position for 15 seconds.

GOLF-BALL ROLL:-

Overpronation leads to wear and tear of plantar fascia and degeneration of structures due to biomechanical issues of foot,(i.e) pronation of foot,while rolling the golf –ball the toes are pulled towards the shin. The active stretch will result in a release on flexor muscles on pronated foot ,which can effectively release tension and helps realign the structures .

GOLF-BALL ROLL EXERCISE



SQUATTING EXERCISES:-

Balance and bend your knee to perform a small squat, it is actually just a small knee bend. When both the knees gets bended forward it leads to squatting . While squatting the hips level among with the knees aligned over the second toe. This strong neutralization of foot neutralization of each foot alternatively and realigns the foot

SINGLE LEG SQUATS:-

This is not a deep squat. The squat is done only on single leg and the other leg is balanced on the floor.

LUNGES:-

The basic lunges occurs when you step forward as far as you can with the rear leg used as a leg and stabilize leg . It looks like a long stride. The rear foot will be pivoted on the toe and the lower body is realigned.

4.DATA ANALYSIS

4.1 Statistical method

The following statistical were employed to analyze the data and testing of hypothesis.

The statistical package was to used to calculate and analyzed the above mentioned descriptive interferential statistic

1. Mean : $\bar{x} = \frac{\sum x}{n}$

2. Standard deviation $SD = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$

3. Paired 't' test

$$T_{cal} = \frac{\bar{d} - \mu_d}{S_d / \sqrt{n}}$$

Where d = mean difference

S_d = Standard deviation

4. Unpaired 't' tests

$$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{SE}$$

$$SE = S \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

$$\text{Where } S = \sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-3}}$$

n_1, n_2 = Size of the sample of two groups

STATISTICAL ANALYSIS AND DATA INTERPRETATION

4.2 Table : I

COMPARISON OF PRE TEST AND POST TEST OF NUMERICAL PAIN RATING SCALE (NPRS) AND, FOOT AND ANKLE ABILITY MEASURE (FAAM) WITHIN GROUP A

	PRETEST		POST TEST			
Group A	Mean	Standard Deviation	Mean	Standard Deviation	T Value	P Value
NRPS	7.13	1.060	1.20	0.775	20.895	0.000
FAAM	60.90	4.047	16.71	2.929	34.979	0.000

The statistical outcomes of descriptive measures on NPRS and FAAM before and after the foot correction Exercises are glanced in table 4.2.

The observed mean 7.13 with standard deviation of 1.060 of NRPS for conventional therapy before intervention is increased to the mean of 1.20 with standard deviation of 0.775 of NRPS after the intervention the percentage is increased in 27.73% to 23.49%

The observed mean 60.90 with standard deviation of 4.047 of FAAM for conventional therapy along with foot correction has improved the mean of 16.71 with standard deviation of 2.929 of FAAM after the intervention with percentage is increased to 60%

4.3 Table : II

COMPARISON OF PRE TEST AND POST TEST OF NUMERICAL PAIN RATING SCALE (NPRS) AND FOOT AND ANKLE ABILITY MEASURE SCALE (FAAM) WITHIN.

GROUP B

	PRETEST		POST TEST			
Group A	Mean	Standard Deviation	Mean	Standard Deviation	T Value	P Value
NRPS	7.27	0.961	4.13	1.246	9.320	0.000
FAAM	58.13	5922	20.92	2.918	19.603	0.000

The statistical outcomes of descriptive measures on NPRS and FAAM before and after conventional therapy in group A are glanced in table

4.3. The observed mean 7.27 with standard deviation of 0.961 of NPRS for conventional treatment before intervention is increased to the mean of 4.13 with standard deviation of 1.246 of NPRS after intervention the percentage has increased to 52.73% The observed mean 58.13 with standard deviation of 5.922 of FAAM for conventional therapy before intervention is increase to the mean of 20.92 with standard deviation of 2.918 of FAAM after the intervention the percentage has increased to 68.76%

4.4 Table III

COMPARISON OF PRETEST AND POST TEST OF NUMERICAL PAIN RATING SCALE (NRPS) BETWEEN GROUP A AND GROUP B

	GROUP A		GROUP B			
Group A	Mean	Standard Deviation	Mean	Standard Deviation	T Value	P Value
PRE TEST	7.13	1.060	7.27	0.961	0.361	0.000
POST TEST	1.20	0.775	4.13	1.246	7.744	0.000

Indicate significant improvement of $P < 0.001$ Table 4.4 shows the statistical outcome of paired Table 4.4 shows the statistical outcome of paired t test analysis on NPRS before and after the conventional and posture correction of is done .

The intervention of group A and group B for NPRS, the test 't' value for test is 0.361 and post test is 7.744 it was concluded to be significant that the group A in t value get differs in NRPS.

4.5 Table IV

**COMPARISON OF PRETEST AND POST TEST OF FOOT AND ANKLE
ABILITY MEASURE SCALE (FAAM) BETWEEN GROUP A AND GROUP B**

	GROUP A		GROUP B		T Value	P Value
	Mean	Standard Deviation	Mean	Standard Deviation		
PRE TEST	60.9	4.047	58.13	5.922	32,458	0.000
POST TEST	16.71	2.929	20.92	2.918	24,327	0.000

Indicates significant improvement $P < 0.001$

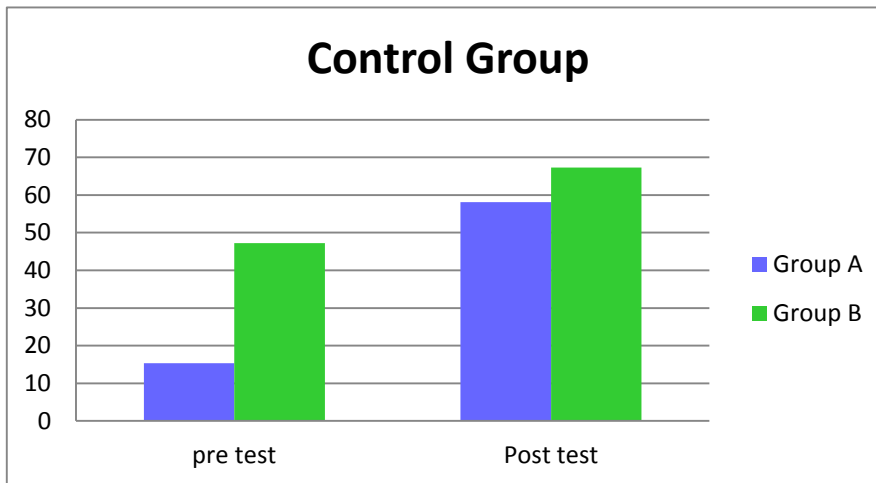
Table 4.5 shows the statistical outcome of paired test Analysis on FAAM before and after the conventional and foot correction exercise program.

The intervention of group A and group b for NPRS the 't' value for pre test is 1.494 and post test is 3.988 it was concluded to be significant that group A in t value for FAAM .

4.6 GRAPHICAL REPRESENTATION

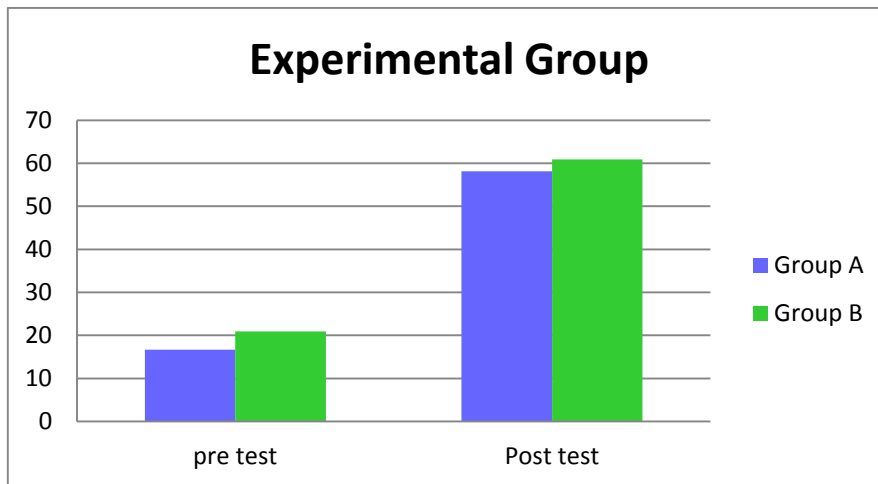
Graph- I

COMPARISON OF PRE- TEST AND POST TEST OF (NPRS) NUMERICAL PAIN RATING SCALE BETWEEN GROUP A AND GROUP B.



Graph – II

COMPARISON OF PRE TEST AND POST TEST OF FOOT AND ANKLE ABILITY MEASURE (FAAM) SCALE BETWEEN THE GROUP A AND GROUP B



5. RESULT

The study was done on 30 subjects, which consisted of 15 subjects each for 14 weeks duration.

The result shows that

Mean value of independent variable between pre and post score for posterior impingement syndrome treatment shows less difference improvement, in group A

Mean value of different variable between pre and post score for conventional treatment shows kinematic difference in improvement.

Paired 't' tests value of pre and post score shows significant difference in posterior ankle impingement syndrome in dancers group.

Paired 't' tests value of pre and post score shows foot corrective changes in posture as a conservative treatment.

In paired 't' tests posterior Impingement shows highly significant difference in improving pain and disability in dancer's heel.

The mean difference of posterior impingement syndrome group shows significant difference in acute stage of PAIS, and in conservative management consistency of good posture is maintained.

In this experimental study after 14 weeks of treatment for 2 groups of 30 patients strengthening protocol exercises, Balance exercises along with OKC and CKC Exercises are given and at conventional management in PAIS in sub acute phase, we found that from the statistical Analysis the S group A procedures along with conventional Treatment with Group B has improved the foot posture correction in PAIS.

Comparison is done in post test scores using FAAM scale by conducting unpaired t test between the groups (A and B) .

7.13 with standard deviation of 1.060/1.20, 0.775 and standard error of mean of 60.90 for group A and mean of 4.047/2.929 with standard deviation of 16-17, 2.929 and standard error of mean of 5.922 for Group b with mean difference of 68.13

6. DISCUSSION

Our foot are the foundation every time we walk, jump or stand. The impact from these simple daily activities, combined with the weight of the human body can place a great deal of strain on the heel and arch of. These strain and pain may result in gait abnormalities like over pronation of foot resulting in poor posture.

Pronation is actually a motion. pronation is the combination of plantar flexion (foot pointing downward) Eversion (the heel curving outward) and abduction (the foot moving outward) this leads to changes in the foot posture and ROM in dancing²⁷.

The pain rating scales like numerical Rating pain scale is used in group A and FAAM used in subjects group B with assessing the pain, conventional therapy is given and after conventional therapy the group B subjects are given the above mentioned exercise along with foot posture correction²⁸

Exercises are given to improved ROM, strengthen the ankle and to bring back the return to play. The soft tissue impingement structures can be compressed are the development of symptoms, the inflammatory tissue, thickening of capsule are the contributing factors of development of condition, in sports, athletes, ballet dancing, lower limb kinematic chain dysfunction and poor posture are the factors complained in PAIS in professional ballet dancers²⁹.

In this study are particular group 'A' responded well during the initial injury, on conventional therapy in group B it responses well in conventional along with foot correction exercises³⁰.

Non-operative treatment consisting of physical therapy and rehabilitation was shown to be successful in approximately 70% of patients with posterior ankle impingement. The treatment consisted of ice, rest, avoidance of forced planter flexion for all patients, along with OKCE and CKCE exercise, strengthening, balancing, exercises are given³¹.

A strengthening program balance exercises, ROM Exercises, OKCE and CKCE that progressively increase in intensity helped improve the static and dynamic stabilization of the ankle and prevent recurrence of injury in both group A and B and have reduced pain and improved functional ability³².

Patients in Group B received foot correction exercises along with conventional exercises. Overpronation is corrected by assessing the feet and ankles the best way correction is neutralization of foot. The patient is asked to roll the foot inward (overpronate) the therapist feel a pressure on the thumb. Rolling outward (oversupinates) This anatomical neutral position for the foot and ankle. Most patients will have to supinate to get neutral from their dysfunctional overpronated position³³.

The patient is asked to maintain the position and are instructed or corrected to push their big toe down without collapsing the ankle or foot, this helps to improves in better correction of foot³⁴.

In overpronation the ankle rolls too far downward and inward with step. If continues to roll when the toes should be starting to push off. As a result ,the big toe should be starting to push off. As a result, the big toe and the second toe to do all of the push off and the foot twists more with each step³⁵.

Overpronation leads to strain on the big toe and the second toe to instability of the foot. For this Toe Splay, can be done for correcting and stabilizing the foot and ankle is neutralize in position³⁶.

An increased risk of injury and heel pain may also be the result of stress on the ligaments and tendons of the foot due to overpronation³⁷.

Big Toe Push Down-the best corrective exercises given to reduce the stress ,tension build on the ligaments and tendons, this also helps in realignment of foot³⁸.

Some of the corrective exercises like squatting, lunges may develop stability to the foot and retrains the foot to perform the functional ability³⁹.

Strengthening exercises such as towel scrunches builds strength to the pronated foot .This involves correction of foot⁴⁰.

Overpronation due to rolling too far inward also can be managed by golf –ball rolling. This provides an active stretch and releases the tension which effectively realigns the structure⁴¹.

Improvement in dynamic stability and correction of overpronation foot achieved in participants of Group B would optimize the dynamic ankle stability to prevent the recurrence of injury. As literature is lacking good quality outcome studies investigating the optimal treatment of ankle impingement .This study recommends including foot posture correction exercises along with other conventional treatment options in patients diagnosed with PAIS especially in dancer and sports person.

7. CONCLUSION

Hence, it is concluded that the conventional therapy with OKCE and CKC exercise program in addition with foot correction exercises has improved the functional ability of foot in patients with Posterior Ankle Impingement Syndrome.

8.LIMITATIONS AND RECOMMENDATIONS

Limitations:-

- This study was very short term and therefore to make it more valid long term is necessary.
- Since the study has been done with smaller number of subjects further studies should be conducted with large group of participants.
- Further studies can be done along with de - loading Techniques and other forms of aerobic exercise.
- Study conducted only on injured foot (age ranges from 18-25 years.)

Recommendations :-

- To conduct a comparative study on dancers foot and non – dancers foot.
- To conduct study on various population
- To do an Experimental study on Patients with injured heel and non-injured heel.

9.REFERENCES

- 1.Jao Paulo (2005)** - Pathomechanics of Posterior Ankle Impingement in Female Ballet dancers
- 2.Howse J (2000)** - The challenge of adolescent dancers
- 3.Bauman, Batson, (1996)**- Common Foot, Ankle and Knee problems in professional dancers
- 4.Mc Eawn and wyon, (1984)** - physiologic profiles of females professional ballerinas, clinic in sports medicine
- 5.Ahonen J (2008)** – Biomechanics of Foot in dance-A Literature review, Journal of dance & medicine
- 6.Bureau NJ, Cardinal (2000)** - Posterior Ankle Impingement Syndrome.MRI findings and radiology
- 7. Albeiseitti w. Ometti (2009)** - clinical evaluation and treatment of Posterior Impingement in dancers
- 8.Donald A. Ozello (2008)** - Posterior Impingement Syndrome
- 9.Bronner and Rose (2007)** - Injuries in a modern dance company : effect of comprehensive management on injury incidence and time loss
- 10.Kadel,N.J (2006)**- Foot and Ankle injury in dance , physical medical Rehabilitation-clinical evaluation and treatment of Posterior Impingement in dancers
- 11.Pascale.V (2009)**- Clinical Evaluation and treatment of posterior impingement in dancers.
- 12.Dimmick S, Linklater J , Kevin J (2016)** - Journal of orthopaedic surgery and Research on Ankle Impingement Syndrome
- 13.Robinson , White. LM (2007)** - Soft tissue and osseous impingement syndrome of the ankle; Role of imaging ,diagnosis and management
- 14.Isabelle Senecal , (2011)** - Conservative management of Posterior Ankle Impingement: a case study

15.Hobdin R,Aubin B (2000) – Posterior Ankle Impingement ;MR imaging findings in seven patients

16.Geppert MJ (1996) - Pain in the posterior aspect in ankle dancers and its differential non-operative treatment and diagnosis

17.Kalina, R Neoral (2011) – Experiences and first outcome of Posterior Ankle Impingement Syndrome

18.Wredmark T,Bauer (1991) - Os Trigonum:A clinical study in ballet dancers, foot and ankle

19.Deepak P Patikar (1998) - Posterior Ankle Impingement due to Os Trigonum

20.D.Caine (2016) - A survey of injuries affecting pre-professional ballet dancers

21.Joel Schwarz (2000) - Ballet dancers injuries as common, and severity in athletic injuries

22.Andrea Fergus, Joyce Maring (1994) - Injury pattern in Elite professional ballet Dancers and the ability of screening program to identify Risk characteristics

23.Benedetti (2004) – study on therapeutic exercise program for Foot and Ankle

24.Fransisco Jose Sobrino (2015) – Overuse injuries in professional Ballet and injury based differences among Ballet disciplines

25.Jeffery A Rusell (2013) - prevention of dance injuries and current perspectives

6.Aena Aalten (2014) -Theorizing, Training: injuries and pain in Ballet dancers

27.Arun Pal Singh (2004) – Study on overpronation of Foot , Bone and Spine

28.Mazaheri. M, Karimi A,Feizi A (2017) - Reliability and Validity of Foot and Ankle Ability Measure (FAAM) to measure functional limitations in patients with Foot and Ankle disorders

29. Brodrik A (2013) - Mechanisms and dysfunctional movement patterns of Foot

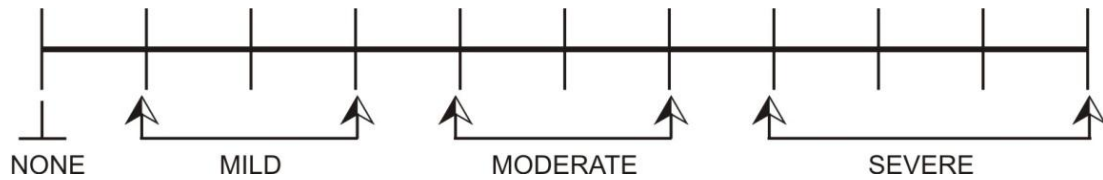
30.Wuchik Dk ,Tuason DA (2011) - Diagnosis and treatment of chronic treatment 60:335-350.

31.Hedrick MR,MC Bryde A.M (2007) - Posterior Impingement Syndrome of Ankle

- 2.Vanochten JM,D. Bierma (2014)** - Chronic complaints after ankle sprains ; a systemic review on effectiveness of treatments. Journal on orthosports:44(11):862-871
- 33.Fong DT, Y.chan (2007)** – A systematic review on ankle injury and ankle sprain in sports:37(1): 73-94
- 34.Michell milliner (2004)** – Clinical Physical Therapy and Training for overpronation
- 35.Mann RA (2006)** - Biomechanics of running , Symposium on the foot and leg in Running Sports , pp-1-29
- 36.Taylor , paul M , Diane (1988)** – conquering Athletic injuries
- 37.Albornoz, M , Maldonado (2015)** -Therapeutic physical exercise for lower limb overpronation in young athletes
- 38.Hyrosomallis C (2007)** - Relationship between balance ability training and sports injury risk Journal Medicine Sports 2007 , 37 ; 547-556
- 39.Lynn SK , Tsang KK (2012)** –Difference in static and dynamic balance task performance after 4 weeks of intrinsic foot muscle training ; the short – foot versus the towel curl exercise . Journal Sport Rehabilitation .
- 40.Yoon, s.w ., Jeong - T.H (2015)** – Effect of overpronation and underpronation , Correction Retrieved from foot-health Rehabilitation.
- 41.Roggers J , MC Court p (2010)** – Posterior ankle impingement Syndrome ; a clinical review with reference to horizontal jump athletes.

APPENDIX - I

0 – 10 NUMERICAL PAIN RATING SCALE



- Point to the number that best represents the intensity of your pain now.
- Document the numerical value indicated by the patient
- Evaluate the pain intensity on time to determine the effectiveness of pain treatments and need for changes in treatment.

APPENDIX– II

FOOT AND ANKLE ABILITY MEASURE (FAAM)

Name :

Date :

Please answer every question by circling one response that most closely describes your condition within the past week. If the activity in questions is limited by something other than you foot or ankle check N/A (Not Applicable)

Activity	No Difficulty	Slight difficulty	Moderate Difficulty	Extreme Difficulty	Unable to do	N/A
Standing	4	3	2	1	0	<input type="checkbox"/>
Walking on even ground	4	3	2	1	0	<input type="checkbox"/>
Walking up hills	4	3	2	1	0	<input type="checkbox"/>
Walking down hills	4	3	2	1	0	<input type="checkbox"/>
Going up stairs	4	3	2	1	0	<input type="checkbox"/>
Going down stairs	4	3	2	1	0	<input type="checkbox"/>
Walking on uneven ground	4	3	2	1	0	<input type="checkbox"/>
Stepping up and down curls	4	3	2	1	0	<input type="checkbox"/>
Squatting	4	3	2	1	0	<input type="checkbox"/>
Coming up on your toes	4	3	2	1	0	<input type="checkbox"/>
Walking initially.	4	3	2	1	0	<input type="checkbox"/>
Walking 5 minutes or less	4	3	2	1	0	<input type="checkbox"/>
Walking approximately 10 minutes	4	3	2	1	0	<input type="checkbox"/>
Walking 15 minutes or greater	4	3	2	1	0	<input type="checkbox"/>
Walking on even ground without shoes.	4	3	2	1	0	<input type="checkbox"/>

APPENDIX - III

DATA COLLECTION SHEET

NAME : DATE :

AGE :

GENDER :

CHIEF COMPLAINTS :

PAIN MEDICAL HISTORY :

PRESENT HISTORY :

GROUP	PRE TEST		POST TEST	
	NPRS	FAAM	NPRS	FAAM

APPENDIX - IV

ASSESSMENT FORM

Name :
Age :
Sex :
Occupation :
Duration :
Chief complaints :
History :
Past History :
Present History :
Associated Problem :
Pain Assessment :
Onset :
Site :
Type :
Side :
Nature : Constant () Intensity ()
Behavior :
Severity : Mild () Moderate () Severe ()

Irritability : Low () Moderate () High ()

Aggravating factor :

Relieving factor :

Area of Referred Pain :

Numerical Pain Rating scale (NPRS)

Foot and ankle ability Measure (FAAM)

On Observation :-

Posture :

Built :

Bony Contours :

Soft Tissue :

Soft Tissue contours :

Assistive device :

Local

Swelling : (RT) (LT)

Redness : (RT) (LT)

Muscle wasting : (RT) (LT)

Deformity : (RT) (LT)

Tropical Changes : (RT) (LT)

On palpation :

Tenderness :

Grade I :

Grade II :

Grade II :

Grade III :

Grade IV :

Swelling :

Warmth :

Edema :

Abnormal Sensation :

Muscle Spasm :

On Examinations

Range of motion :

Joint

Ankle Dorsiflexion : (RT) (LT)

Plantar flexion : (RT) (LT)

Subtalar Inversion : (RT) (LT)

Eversion : (RT) (LT)

Intrinsic Muscles : (RT) (LT)

Deep Tendon Reflexes :

Grade 0 :

Grade 1 :

Grade 2 :

Grade 3 :

Grade 4 :

Functional Assessment

Functional Independence Measure scale

1. Self – Care

Walking

Standing

Climbing

2. Locomotion

Cane

Walker

3. Communication

Comprehensive

Expression

Problem list

Signature of Investigator

Signature of Student

APPENDIX – V

INFORMED CONSENT FORM

Title : Posterior impingement syndrome in dancer's heel.

I hereby consent to involve myself in the above – mentioned dissertation.

Full name of subject : _____

The nature and purpose of the research project was described and explained to me.

I understand it, and agree to take part in the same.

I understand that I may not directly benefit by taking part in the study. I acknowledge that the possible risks and side effects, discomforts and inconvenience, have been fully explained to me.

I understand that I can withdraw from the study any stage. I understand that there is no payment for taking part in this study. I am aware that I should retain a copy of consent from when completed.

I understand that the privacy and confidentiality of any information I provide will be safeguard.

Signature of the subject :

Name of the Address :

I shall inform the research team of any future change of address I wish to remain in contact.

MASTER CHART

GROUP A					GROUP B				
S.NO	NPRS		FAAM		S.NO	NPRS		FAAM	
	Pre Test	Post Test	Pre Test	Post Test		Pre Test	Post Test	Pre Test	Post Test
1	7	1	26.00	59.30	1	7	3	29.12	52.02
2	6	1	18.82	52.75	2	8	6	27.07	55.21
3	8	2	27.41	56.70	3	9	3	23.00	53.44
4	7	0	24.64	54.12	4	7	5	25.54	52.37
5	6	1	27.30	46.45	5	6	3	20.04	58.45
6	6	1	21.12	55.60	6	8	5	26.31	57.64
7	7	0	23.30	57.24	7	7	4	24.44	54.51
8	9	2	20.90	58.84	8	9	6	29.02	51.12
9	6	1	15.31	54.12	9	6	5	23.17	56.45
10	8	2	22.42	53.52	10	7	3	25.12	53.07
11	8	0	26.31	52.65	11	6	6	21.26	52.12
12	7	1	28.14	51.20	12	7	5	27.12	57.14
13	7	2	26.20	57.65	13	8	5	24.14	58.48
14	6	2	21.31	58.20	14	7	2	26.00	55.17
15	9	2	24.41	49.20	15	7	4	24.40	56.32